We claim:

1. A receiver coupled to a first and a second antenna for receiving at least two symbols from a transmitter having at least first and second transmit antennas, comprising:

a first data path for generating a first estimated symbol $\hat{a}_1(f)$ from said first antenna;

a second data path for generating an estimated symbol sum $\hat{a}_s(f)$ from said first and second antennas; and

an interference cancellation module having inputs coupled to the first and second data paths, said interference cancellation module for canceling co-channel interference (CCI) between the estimated symbol sum and the first estimated symbol to generate a second estimated symbol.

2. A receiver according to claim 1, wherein said first and second data paths each comprise a separate chip equalizer.

3. A receiver according to claim 2, further comprising a channel estimator having outputs coupled to inputs of each of said separate chip equalizers.

4. A receiver according to claim 1, wherein said second data path comprises a chip equalizer for generating an estimated chip sum sequence from said first and second receive antennas.

5. A receiver according to claim 1, wherein the interference cancellation module operates using less than all active spreading codes in the system in which the receiver operates.

6. The receiver of claim 5, wherein the interference cancellation module operates using only spreading codes of estimated symbols that are output to a decoder.

7. The receiver of claim 1, wherein said receiver comprises a LMMSE receiver.

8. The receiver of claim 1, wherein the receiver comprises a Kalmann Filter receiver.

9. A receiver according to claim 1 wherein said second data path additionally comprises a unit for performing symbol detection of an estimated chip sum sequence to generate said estimated symbol sum $\hat{a}_s(f)$.

10. A wireless receiver having at least two receive antennas for receiving a transmission from a transmitter having at least two transmit antennas, comprising:

a channel estimator having an input coupled to said at least two receive antennas, a first output, and a second output;

a first chip equalizer having a first input coupled to said at least two receive antennas and a second input of said channel estimator for suppressing inter-chip interference (ICI) and co-channel interference (CCI) from at least one antenna other than a first one of said at least two antennas and for generating an estimated chip sequence from said first antenna, said first chip equalizer having an output coupled to a first processing module for descrambling and despreading the output of said first chip equalizer and generating a first estimated symbol $\hat{a}_1(f)$;

a second chip equalizer having a first input coupled to said at least two receive antennas and a second input comprising said second output of said channel estimator for generating an estimated chip sequence sum from said at least two receive antennas and a residual CCI, said second chip equalizer having an output coupled to a second processing module for descrambling and despreading the output of said second chip equalizer and generating an estimated symbol sum $\hat{a}_s(f)$;

an interference cancellation module, having said first estimated symbol $\hat{a}_1(f)$, said estimated symbol sum $\hat{a}_s(f)$ and an output of said second

equalizer as inputs, for canceling CCI and generating at least one estimated symbol; and

a decoder for decoding said at least one estimated symbols.

11. A system according to claim 10, further comprising a detector to detect a plurality of symbols of k users, said detected symbols being fed back to said interference cancellation module.

12. A system according to claim 10, wherein said second chip equalizer generates a weighted sum of estimated chip sequences ds(f) = d2(f) + b2,1d1(f) + n2(f), where d1 is an estimated chip sequence from a first one of said at least two antennas, d2 is an estimated chip sequence from a second one of said at least two antennas and n2 is a noise term.

13. A method of receiving a transmission in a wireless receiver having at least two receive antennas, said transmission comprising at least two symbols from a transmitter having at least first and second transmit antennas, comprising the steps of:

generating a first estimated symbol $\hat{a}_1(f)$ from said first antenna;

generating an estimated symbol sum $\hat{a}_s(f)$ from said first and second antennas; and

determining a second estimated symbol by canceling interference between the estimated symbol sum and the first estimated symbol.

14. A method according to claim 13, in which said step of generating an estimated symbol sum $\hat{a}_s(f)$ comprises equalizing said input data in an equalizer having optimized filter coefficients W^{opt} and feedback weights B^{opt} that are the solution to:

$$\mathbf{W}^{opt}, \mathbf{B}^{opt} = \arg\min_{\mathbf{W},\mathbf{B}} \mathrm{Trace}(\mathbf{R}_{zz}) = \arg\min_{\mathbf{W},\mathbf{B}} E\|\mathbf{B}^H \mathbf{d}_i - \mathbf{W}^H \mathbf{y}_{i+F:i-F}\|^2,$$
$$\text{s.t.} \quad \mathbf{B} = \begin{bmatrix} 1 & & 0 \\ \vdots & \ddots & \\ b_{M,1} & \dots & 1 \end{bmatrix}. \tag{10}$$

where R_{zz} is an error covariance matrix, E is an error, W is a set of chip equalizers, and B is a set of feedback weights.

15. A wireless receiver coupled to a first and a second receive antennas for receiving a spread spectrum transmission comprising at least two symbols from a transmitter having at least first and second transmit antennas in which not all spreading codes are known, comprising:

means for receiving an input data on a first data path for generating a first estimated symbol $\hat{a}_1(f)$ from said first antenna;

means for receiving said input data on a second data path for generating an estimated symbol sum $\hat{a}_s(f)$ from said first and second antennas;

means for utilizing said first estimated symbol $\hat{a}_1(f)$ and said estimated symbol sum $\hat{a}_s(f)$ as a plurality of inputs to an interference

cancellation module, for canceling CCI and generating at least one estimated symbol; and

means for decoding said at least one estimated symbol.

16. The wireless receiver of claim 15 wherein said first data path comprises a first chip equalizer for generating an estimated chip sequence from said first antenna.

17. The wireless receiver of claim 15, further comprising an equalizer for equalizing said input data, said equalizer having optimized filter coefficients W^{opt} and feedback weights B^{opt} that are the solution to:

$$\mathbf{W}^{opt}, \mathbf{B}^{opt} = \arg\min_{\mathbf{W},\mathbf{B}} \mathrm{Trace}(\mathbf{R}_{zz}) = \arg\min_{\mathbf{W},\mathbf{B}} E\|\mathbf{B}^H \mathbf{d}_i - \mathbf{W}^H \mathbf{y}_{i+F:i-F}\|^2, \quad \text{s.t.} \quad \mathbf{B} = \begin{bmatrix} 1 & & 0 \\ \vdots & \ddots & \\ b_{M,1} & \dots & 1 \end{bmatrix}. \tag{10}$$

where R_{zz} is an error covariance matrix, E is an error, W is a set of chip equalizers, and B is a set of feedback weights.

18. A program of machine-readable instructions, tangibly embodied on an information bearing medium and executable by a digital data processor, to perform actions directed toward receiving from multiple antennas, the actions comprising:

receiving as a first input a first estimated symbol $\hat{a}_1(f)$ derived from a first antenna;

receiving as a second input an estimated symbol sum $\hat{a}_s(f)$ derived from said first antenna and a second antenna; and

calculating a second estimated symbol by canceling interference between the estimated symbol sum and the first estimated symbol.

19. A method for receiving a transmission in a wireless receiver having at least two receive antennas, said transmission comprising at least two symbols from a transmitter having at least first and second transmit antennas, comprising the steps of:

step for generating a first estimated symbol $\hat{a}_1(f)$ from said first antenna;

step for generating an estimated symbol sum $\hat{a}_s(f)$ from said first and second antennas; and

step for determining a second estimated symbol by canceling interference between the estimated symbol sum and the first estimated symbol.